TIMING FIRST IRRIGATIONS FOR COTTON PRODUCTIVITY AND WATER CONSERVATION

R. P. Flynn and C. E. Barnes
Agricultural Experiment Station
New Mexico State University
Artesia, NM

Abstract

Increased demands to conserve agricultural water in the Pecos River Valley of New Mexico has resurrected the importance of irrigation scheduling for cotton production. A study was conducted at the NMSU Agricultural Science Center at Artesia to evaluate timing first irrigations for furrow irrigated cotton based on calculated soil water potentials. Irrigations were scheduled with GOSSYM based on soil water potentials of −0.5, −0.6, −0.7 and −0.8 bar. First irrigations scheduled at −0.5 bar and −0.8 bar negatively affected cotton yields. Cotton yields did best when irrigations were scheduled at soil water potentials of −0.6 or −0.7 bars. Water savings were realized fifty percent of the time when first irrigations were scheduled at soil water potentials of −0.6 bars. As much as six inches of water was conserved when first irrigations were scheduled at −0.7 bars. However, delayed maturity occurred half the time when irrigations were scheduled at −0.7 bars. Computer aided decisions for scheduling first irrigations should be set at −0.6 bars and always be accompanied with visits to the field to confirm program estimates.

Introduction

Computer software for managing cotton has progressed over recent years to cover all aspects of production including irrigation scheduling routines. Setting the parameters for each subroutine is specific for each farm across the cotton belt. New Mexico cotton growers must carefully balance crop production with water conservation that makes computer-assisted decisions an attractive management tool. Cotton fields are typically pre-irrigated in March and planted into moisture. Irrigating too early after planting can cool the soil or cause an increase in disease pressure. Irrigations scheduled too late after planting can cause physiological disorders (Jordan, 1986). A computer program such as Gossym® allows the producer to track soil moisture and crop development. The producer can then schedule field visits to confirm the computer model and more effectively manage their time and resources. The objective of this study was to evaluate potential water savings and the effect on cotton production when Gossym® schedules first irrigations.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:671-673 (1998)
National Cotton Council, Memphis TN

Materials and Methods

The study was conducted at the New Mexico State University Agricultural Science Center at Artesia, NM, from 1993 to 1996. Table 1 describes initial soil characteristics for the site and were used within GOSSYM for specific subroutines. Row width was maintained at a 40" row spacing and the planting rate was 16 pounds of seed per acre for all four years. There were five replicates in a randomized complete block design. All herbicides and pesticides were applied according to label directions (Table 2).

The treatments imposed on flood irrigated upland cotton were soil water potentials of −0.5 (SWP50), −0.6 (SWP60), −0.7 (SWP70), and −0.8 bars (SWP80). Subsequent irrigations were performed when calculated soil water potential reached −0.5 bars. Actual number of irrigations and quantities are presented in Figure 1. There were five replications of each treatment in a randomized complete block design.

Statistical analyses were conducted using the Statistical Analysis System (SAS, 1988) and significance was declared at the 0.10 probability level.

Results and Discussion

Water Conservation

In all four years scheduling the first irrigation when soil moisture reached −0.7 bars or −0.8 bars saved water (Table 3). In two of the four years water savings occurred when the first irrigation was scheduled at a soil water potential of −0.6 bars. Scheduling first irrigations to occur at a soil water potential −0.6 bars could save as much as four acre inches of applied water.

Cotton Performance

Seed cotton yields were dependent on year and treatment. Field observations for first irrigations scheduled at −0.5 bars indicated slower crop development and a tendency for reduced yield (Figure 2). The authors believe this was mainly due to reduced soil temperature early in plant development. First irrigations scheduled at either −0.6 or −0.7 bars had a tendency to improve seed cotton yields over −0.5 bar. However, in two of the four years of this study, first irrigations scheduled at −0.7 bars experienced delayed maturity (Figure 3). First irrigation scheduled at −0.8 bars generally reduced seed cotton production. Best yields were in 1996 for all treatments (Figure 2).

Conclusion

Best management practices for cotton production should include utilizing computer programs that assist in scheduling irrigations. Allowing the calculated soil water potential to reach −0.6 or −0.7 bar does not have a negative effect on total cotton yield. However, since maturity was delayed in two of the four years when first irrigations were scheduled at −0.7 bars this level of soil water potential is not recommended. Additionally, depending on rain and the growing conditions for any given year, water savings of up to 4 acre inches were realized when first irrigations were based on soil water potentials of −0.6 bars. Finally, all computer programs need to be updated and verified with actual field conditions in order to perform well under irrigated New Mexico conditions.

References

GOSSYM-COMAX Users's Manual. January 1992. USDA-ES GOSSYM-COMAX Information Unit. 102 Mississippi Technology Center. Starkville, MS 39759

Jordan, W. R. 1986. Water deficits and reproduction. *In* Cotton Physiology: Number 1, The Cotton Foundation Reference Book Series. ed. J.R. Mauney and J. McD. Stewart. The Cotton Foundation. Memphis, TN

O'Connor, G.A., R.S. Bowman, M.A. Elrashidi and R. Keren. 1983. Solute retention and mobility in New Mexico soils. I. Characterization of solute retention reactions. NMSU Agricultural Experiment Station Bulletin 701. Las Cruces, NM.

SAS Institute, 1988. SAS/STAT User's Guide, Release 6.03 Edition. SAS Institute, Inc., Cary, NC.

Table 1. Selected soil information for Initial Irrigation Study on Cotton, 1993 - 1996, Artesia, NM.

Year	Previous Crop	Soil Texture	Depth	NO_3-N	Organic Matter	P†	K ‡	ρH
			inches	ppm	%	ppm	ppm	
1993	Cotton	clay loam¶	0-6	13	1.4	12	567	8.1
1994	Cotton	clay loam	0-6	47	1.3	4	509	7.8
1995	Cotton	silt loam §	0-6	18	1.3	6	389	7.8
1996	Cotton	silt loam	0-12	16	1.7	3	490	7.8

† Bicarbonate extractable phosphorus

‡ Ammonium acetate extractable potassium

¶ Reagan series, 20% calcium carbonate equivalence, 18 meq/100g CEC (*O'Connor et al., 1983*)

§Pima soil series, 20% calcium carbonate equivalence, 15 meq/100g CEC

Table 2. Cultural practices for Irrigation Timing study, Artesia, NM.

Year	Fertilizer Applied	Herbicides and Pesticides†	Acala Variety	Harvest Population
	rate/blend	Common name		plants/A
1993	200 lbs/A 0-46-0	Trifluralin, Aldicarb, Cyanazine	1517-88	49,000
1994	120 lbs/A 0-46-0	Trifluralin + Prometryn, Aldicarb	1517-91	23,000
1995	120 lbs/A 11-52-0 + 50 lb N/A	Pendimethalin, Aldicarb, Profenofos	1517-91	24,000
1996	220 lb/A 11-52-0	Trifluralin, Aldicarb	1517-95	28,000

† Label directions followed in all cases for appropriate use.

Table 3. Water conserved as a result of timing first irrigation based on soil water potentials greater than -0.5 bar.

Year	Treatment		
	−0.6 bar	−0.7 bar	−0.8 bar
	acre inches		
1993	0.0	4.0	2.0
1994	1.0	2.5	2.5
1995	0.0	6.0	8.25
1996	4.0	4.0	4.5

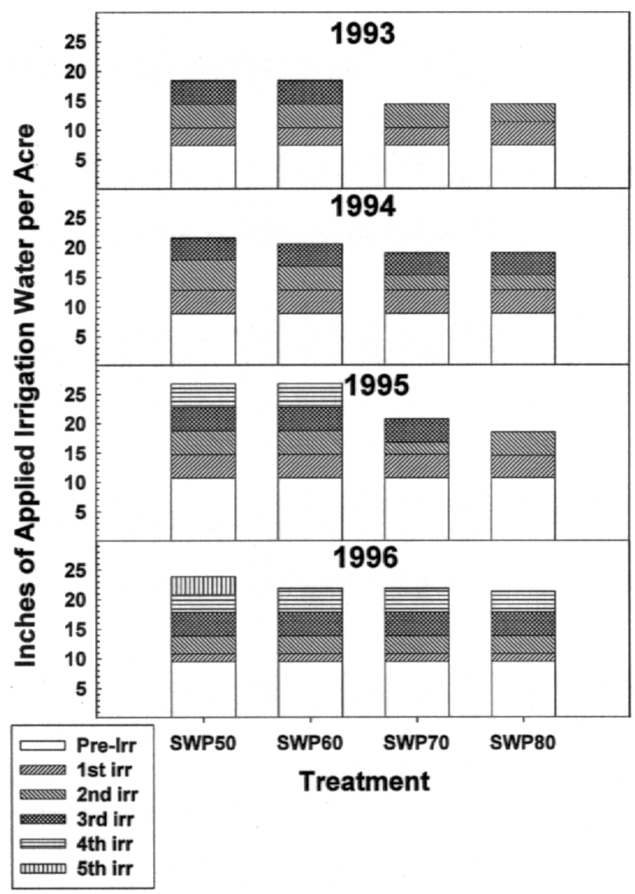

Figure 1. Actual number and quantity of irrigation water applied based on timing first irrigations on soil water potentials of -0.5 (SWP50), -0.6 (SWP60), -0.7 (SWP70), or -0.8 bars (SWP80).

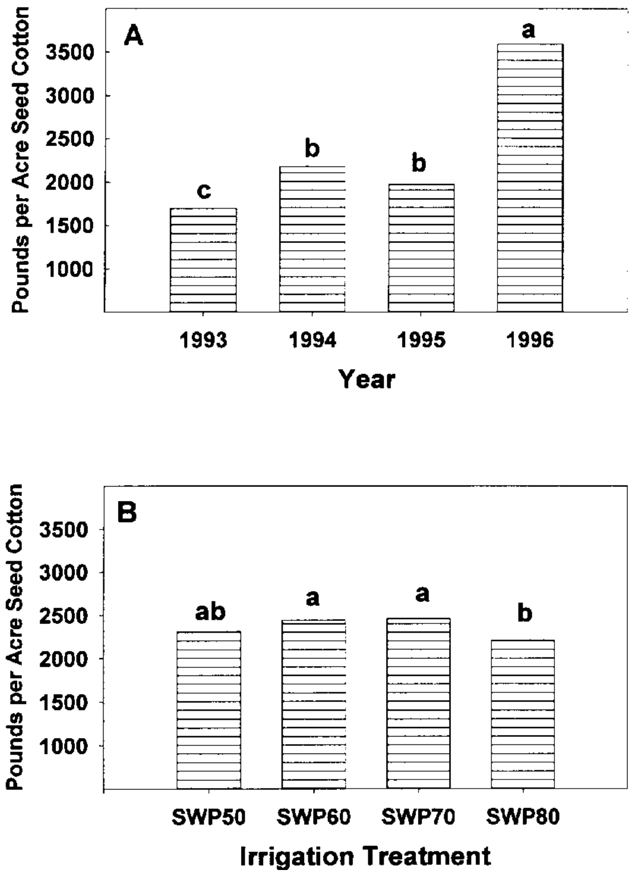

Figure 2. Seed cotton yields affected by year (A) and timing first irrigations (B) based on soil water potentials of -0.5 (SWP50), -0.6 (SWP60), -0.7 (SWP70), or -0.8 bars (SWP80). There was no interaction between year and treatment.

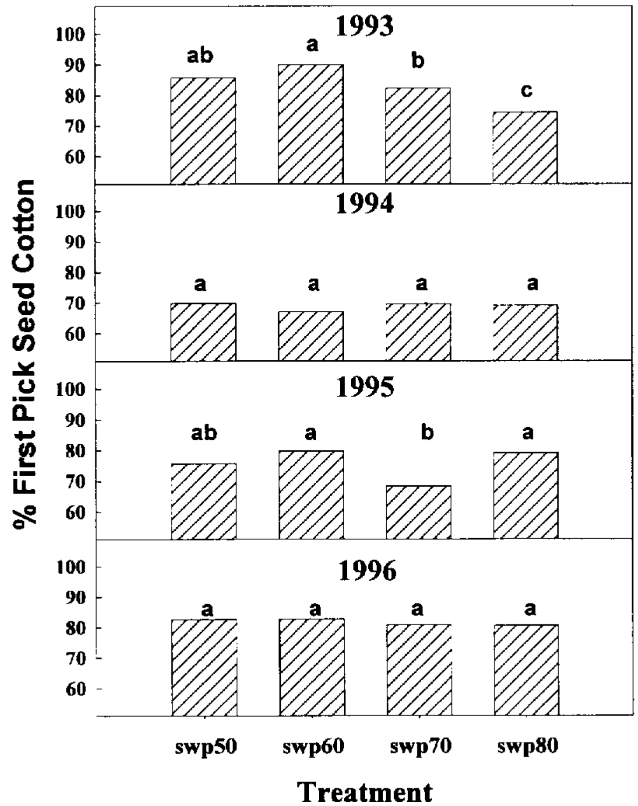

Figure 3. Percentage first pick seed cotton yield as affected by timing first irrigations based on soil water potentials of -0.5 (SWP50), -0.6 (SWP60), -0.7 (SWP70), or -0.8 bars (SWP80).